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A new species of *Macrobrachium* (Crustacea: Decapoda: Palaemonidae), with abbreviated development, from Veracruz, Mexico

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Abstract.—*Macrobrachium tuxtlaense,* a new epigean species of freshwater prawn with abbreviated development from Los Tuxtlas region in the state of Veracruz, Mexico, is described. The new species is most similar to the cave-dwelling *M. acherontium* Holthuis and *M. villalobosi* Hobbs, the two previously known species from Mexico with abbreviated development.

Although abbreviated development is a widespread characteristic among species of Palaemoninae (Pereira & García 1995), which comprises mostly freshwater and estuarine shrimps, only two cave-dwelling species of *Macrobrachium* Bate, 1868 from North America (Mexico and the United States) present this kind of development: *M. villalobosi* Hobbs, 1973 and *M. acherontium* Holthuis, 1977. Until now, within the Palaemoninae from North America, the only epigean species with abbreviated development belonged to *Palaemonetes,* Heller, 1869; and *Cryphiops* (*Bithynops*) Villalobos et al., 1989. In this study we describe a new epigean species of *Macrobrachium* from Los Tuxtlas region, Veracruz, in which females carry few (10–20), large eggs (mean size 2.8 mm by 2.5 mm), and an abbreviated development is present as evidenced by the morphology of the first larval stage (Fig. 1). The presence in the first larval stage of all five pairs of pereiopods, well developed pleopods, and a fan shaped telson, indicate a partially abbreviated development with two larval stages according to Jalihal et al. (1993).

All specimens used are deposited in the Colección Nacional de Crustáceos, Instituto de Biología, Universidad Nacional Autónoma de México (CNCR). Abbreviations used are: cl, carapace length; tl, total length.

Macrobrachium tuxtlaense, new species
Figs. 1–3

Material examined.—Holotype: 1 ♂ cl 10.4 mm, tl 40.5 mm, small stream 1 km S of Coyame (18°26′N, 95°7′W), tributary of lake Catemaco, Municipio de Catemaco, Veracruz, México, Aug 1994, colls. F. Alvarez, M. E. Camacho, J. L. Villalobos, CNCR 13174. Allotype: 1 ♀ cl 8.6 mm, tl 34.3 mm, same locality, date, and collectors as holotype, CNCR 13174. Paratypes: 6 ♂ cl 7.7–10.0 mm, tl 31.5–37.6 mm; 3 ♀ cl 8.5–9.7 mm, tl 33.4–35.3 mm; same locality, date, and collectors as holotype, CNCR 13175. Non-paratypes: 8 ♂ cl 6.4–10.8 mm, tl 26.8–42.2 mm; 12 ♀ cl 6.4–10.8 mm, tl 25.5–40.8 mm, stream 1 km S of Las Margaritas, tributary of lake Catemaco, Municipio de Catemaco, Veracruz, México, Mar 1997, colls. J. C. Molinero, R. Robles, CNCR 17428.

Description.—Small sized shrimp, maximum known size 42.2 mm tl (Fig. 2a). Rostrum reaching beyond distal margin of third segment of antennular peduncle, median rib present along inferior half. Dorsal margin arched, distal third elevated, proxi-

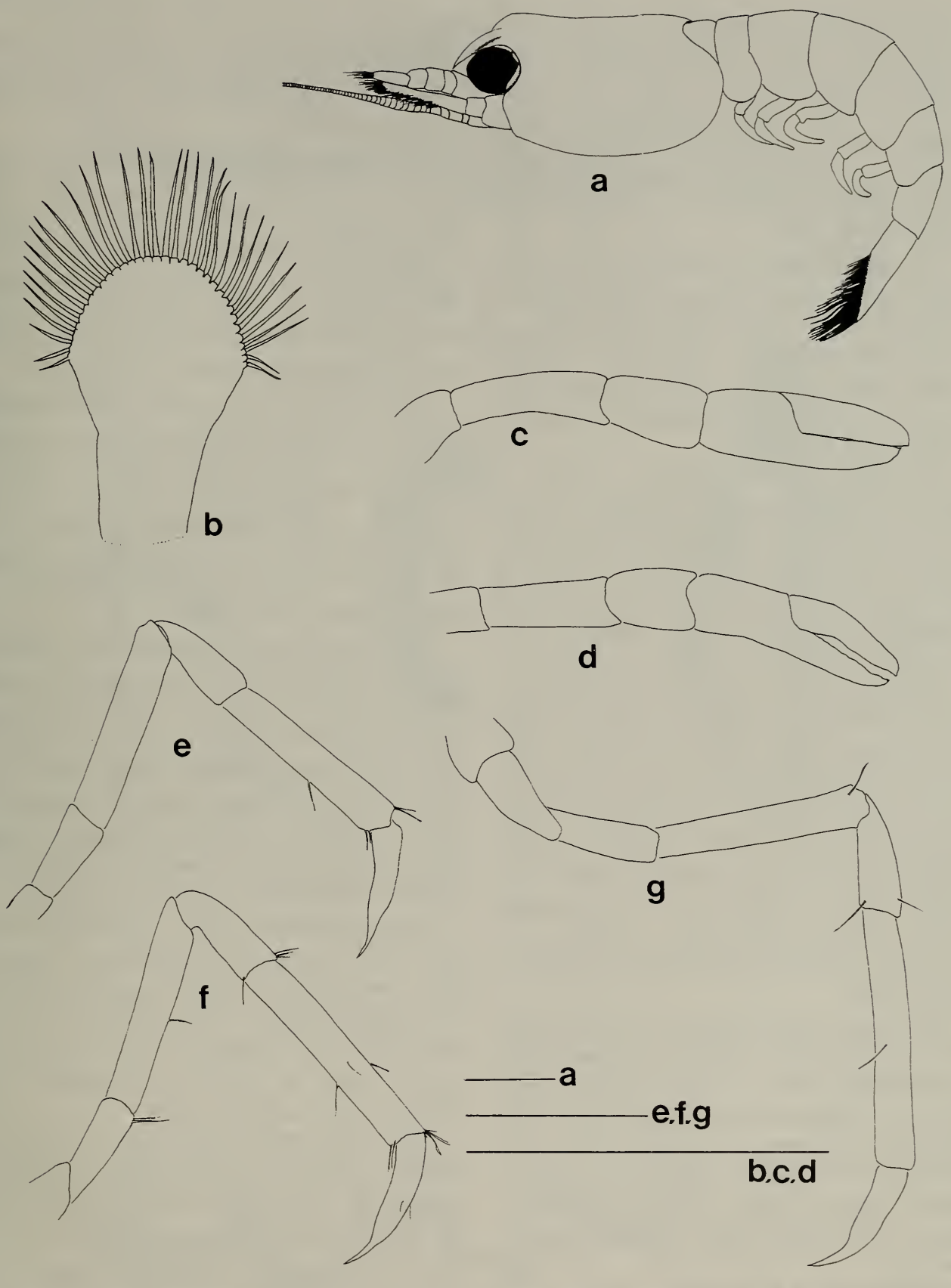

Fig. 1. *Macrobrachium tuxtlaense* new species, first larval stage CNCR 13174b: a, lateral view; b, telson; c, first pereiopod; d, second pereiopod; e, third pereiopod; f, fourth pereiopod; g, fifth pereiopod. Scale bars represent 1 mm.

mal ⅔ oriented downwards; with 9 to 11 short, acute teeth, pointing forward, with setae in between; first 2 teeth located posterior to orbit. Distal ⅔ of ventral margin arched, with 2 teeth, distal one under second and third teeth of dorsal margin and proximal one under third and fourth teeth of dorsal margin.

Carapace smooth, with antennal and hepatic spines. Antennal spine slightly below inferior orbital angle, submarginal; hepatic spine slightly behind and under antennal spine. Inferior orbital angle rounded. Hepatic groove deep, anterior half oriented towards antennal spine.

Abdomen smooth, inferior margin of pleurae of first 3 somites rounded. Posterolateral angle of fourth and fifth somites subacute. Sixth somite 1.7 times as long as fifth; posterior margin with rounded notch flanked by acute angles, and adjacent to articulation of external ramus of uropods.

Telson (Fig. 2e) reaching distal fourth of internal ramus of uropods, narrowing distally; armed with 2 pairs of small, acute dorsal spines on posterior half, first pair at ½ the length of telson, second pair at ¾ the length of telson. Posterior margin subacute, bearing 10–12 thick, plumose setae; distolateral angles armed with 2 articulated spines, internal pair longest reaching beyond tip of telson, external pair ⅓ length of internal pair.

Eyes pigmented, cornea normally developed, globose, wider than ocular peduncle.

Antennules (Fig. 2b) with slender, acute stylocerite, tip reaching beyond half of first peduncular segment. First peduncular segment depressed, concave dorsally to fit eye; lateral margin ending in slender, acute spine; second and third segments subcylindrical.

Antennae with basicerite armed on anterior margin with acute, slender spine. Scaphocerite (Fig. 2c) tapering anteriorly, 2.8 times as long as wide; lateral margin ending distally in short spine, not overreaching distal margin.

Mandibles (Fig. 3a) with 3-segmented palp bearing long setae on tip and articulations; incisor process with 3 conical teeth, molar process with 2 wide, rounded teeth on mesial border.

Maxillules (Fig. 3b) with bilobed palp; distal lobe slender with long, single, subapical seta on anterior margin; proximal lobe rounded, with 1–3 apical setae. Mesial margin of anterior lacinia armed with spiniform teeth, anterior and posterior margins bearing thin setae; posterior lacinia curved with abundant thin setae on distal half.

Maxillae (Fig. 3c) with scaphognathite bordered with plumose setae, anterior lobe narrower and longer than posterior; palp devoid of setae, thick proximally, tapering abruptly on distal half, ending in sharp tip; endite bilobed, divided by deep incision along ¾ of its length, both lobes slender and with terminal tuft of setae.

First maxilliped (Fig. 3d) with 2 endites bearing marginal and submarginal setae, anterior endite twice as long as posterior endite. Exopod slender, 4 times as long as palp, distal third bearing long setae; caridean lobe well formed, fused to base of exopod, bordered with long, plumose setae; palp strong basally, tapering distally; epipodite subtriangular, distal tip rounded.

Second maxilliped (Fig. 3e) subpediform with well developed podobranch; endopodite 4-segmented, distal 2 segments oriented mesially, gnathal border armed with setae and spines; exopodite slender, approximately twice as long as endopodite, tip bearing long, plumose setae.

Third maxilliped (Fig. 3f) pediform, slender, reaching distal margin of second segment of antennular peduncle; with well developed arthrobranch; coxa with rounded, chitinized plate; basis short, bearing articulations with endopodite and exopodite at same level. Endopodite 3-segmented, bearing tufts of setae, becoming denser distally; first segment slender, 1.15 times as long as second segment; third segment shorter than second, ending in rounded tip. Exopodite slender, longer than first segment

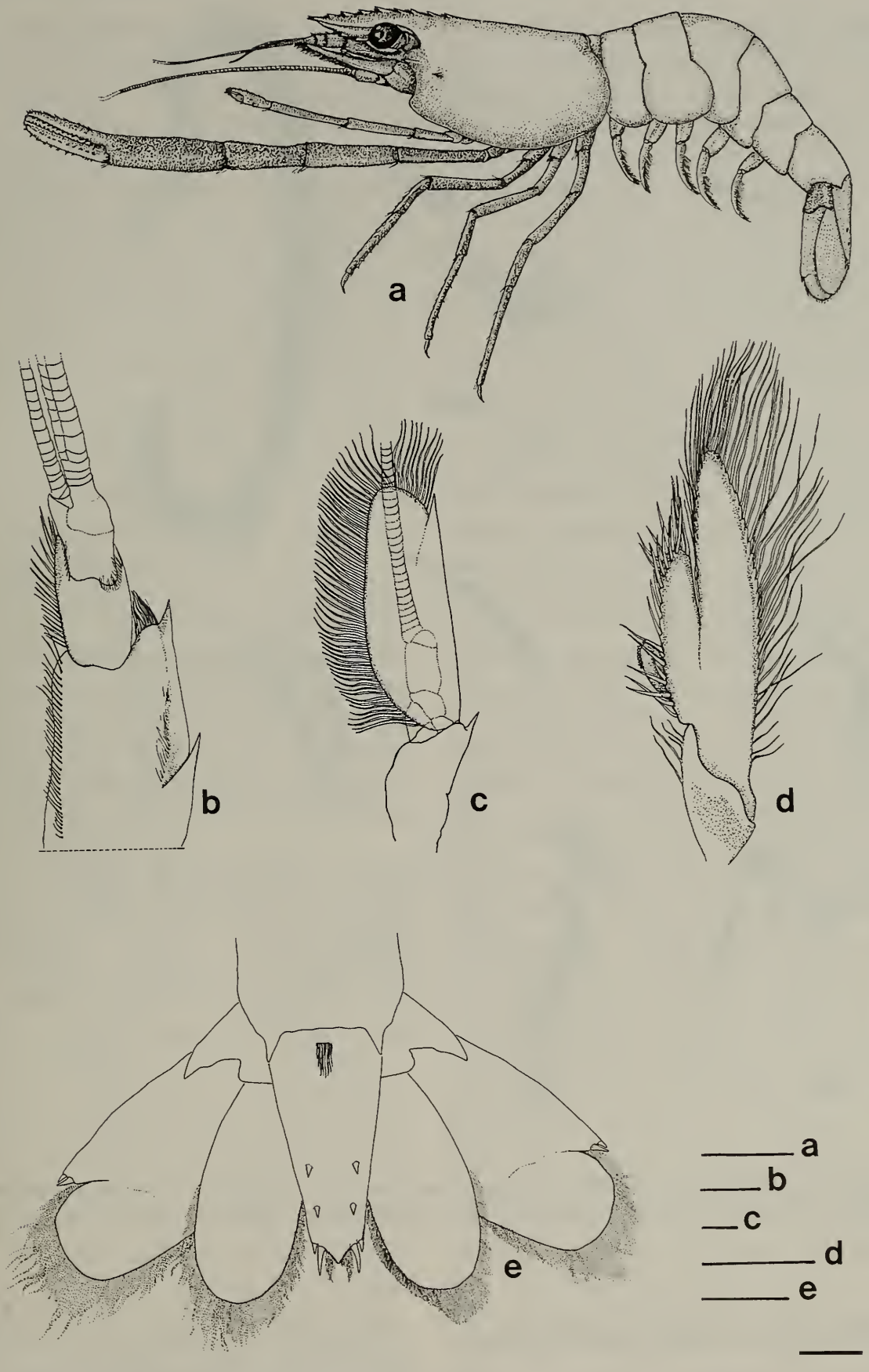

Fig. 2. *Macrobrachium tuxtlaense* new species, male holotype CNCR 13174: a, lateral view; b, distal portion of antennular peduncle; c, distal portion of antennal peduncle; d, appendix masculina on second pleopod; e, telson and uropods, dorsal view. Scales equal 5 mm (a), 1 mm (b–d), and 2 mm (e).

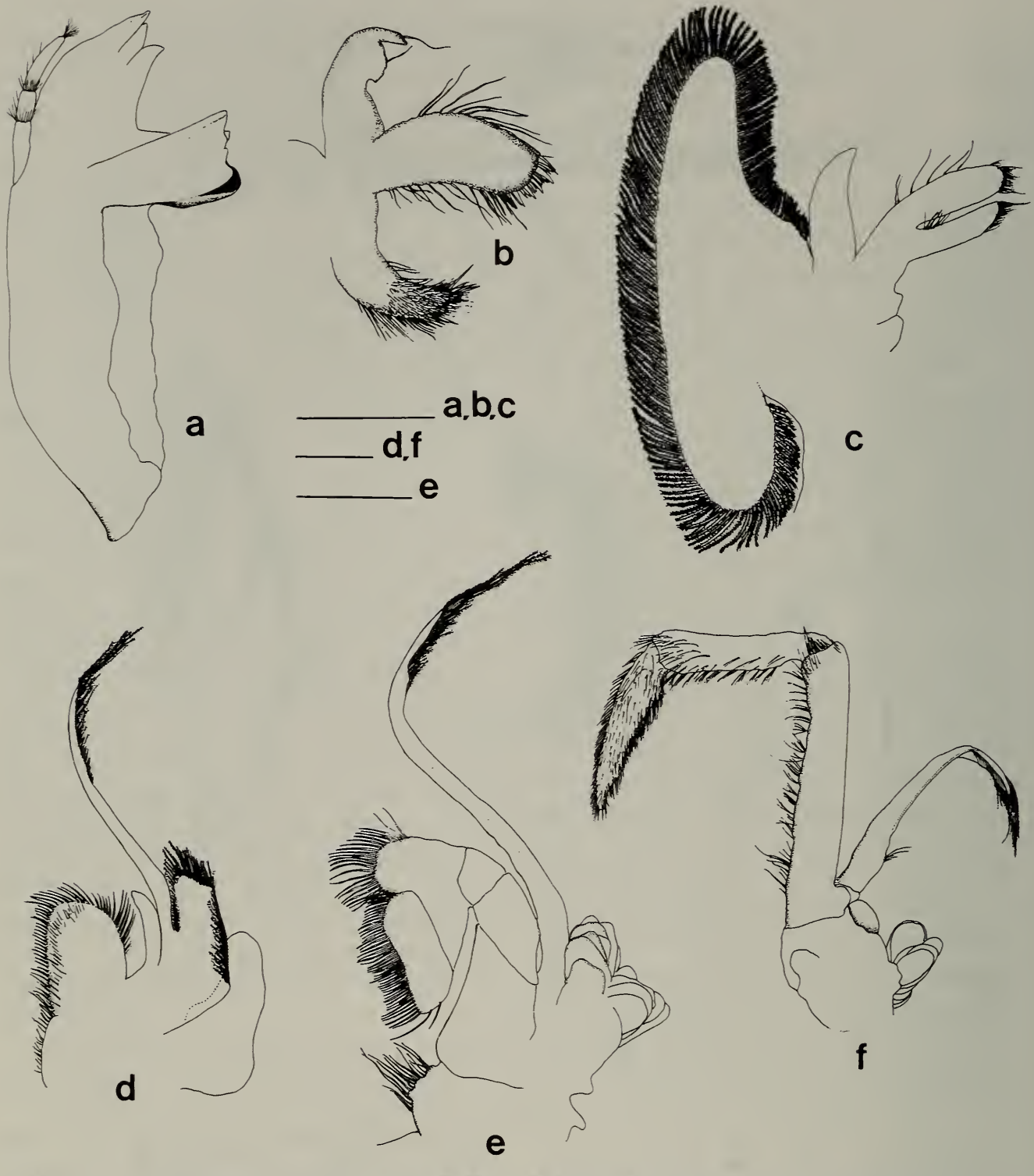

Fig. 3. *Macrobrachium tuxtlaense* new species, male holotype CNCR 13174: a, right mandible; b, right maxillule; c, right maxilla; d, first maxilliped; e, second maxilliped; f, third maxilliped. Scale bars represent 1 mm.

of endopodite, distal third bearing long setae.

First pair of chelipeds slender, shorter than second, distal margin of carpus reaching beyond scaphocerite. Ischium short, 0.65 times as long as merus, 0.57 as long as carpus, subequal in length to chela; ventral margin with tufts of setae on proximal half. Merus shorter than carpus, 1.4 times length of chela, dorsal and ventral margins parallel. Carpus smooth, slender, widening distally, 1.54 times length of chela. Chela wider than distal portion of carpus; palm slightly longer than fingers, with line of se-

tae on proximoventral margin; fingers straight, slightly gaping, with tufts of setae on distal half, tips subacute and corneous, bearing short setae; cutting edge hard, chitinized, devoid of teeth.

Second pair of chelipeds subequal, long, covered with granules and small spines; proximal third of carpus reaching beyond scaphocerite. Ischium moderately compressed, dorsal and ventral margins parallel, of same length as merus and carpus, 0.53 times length of chela. Merus cylindrical, 5 times as long as wide, of same length as carpus, half as long as chela. Carpus becoming slightly wider distally, 3.7 times as long as distal width, 0.52 times length of chela. Chela moderately compressed, dorsal and ventral margins parallel, 6 times as long as high; palm as long as ischium, merus, and carpus, 0.52 times the length of chela, 1.18 times length of movable finger. Fingers slender, covered with scattered setae, tips acute and corneous; cutting margin with conical teeth on proximal half, becoming continuous smooth ridge distally; dactyl with 4 teeth, fixed finger with 5 teeth, distal 2 teeth the largest.

Third to fifth pair of pereiopods slender, increasing in length posteriorly; with scattered short setae, 2 rows of spinules along posterior margin of propodus, tuft of setae on propodus-dactyl articulation, and row of setae along superior border of dactyl; dactyl the shortest segment, ending in sharp tip.

Third pair of pereiopods with distal third of propodus reaching beyond scaphocerite; ischium half length of merus and propodus, subequal in length to carpus, 1.5 times length of dactyl; merus 1.9 times length of carpus, 3.2 times length of dactyl, of same length as propodus; carpus 0.52 times length of propodus, 1.6 times length of dactyl; propodus 3.2 times length of dactyl.

Fourth pair of pereiopods with distal fourth of propodus reaching beyond scaphocerite; ischium half length of merus and propodus, of same length as carpus, 1.6 times length of dactyl; merus 1.63 times length of carpus, 3.4 times length of dactyl, of same length as propodus; carpus 0.6 times length of propodus, twice as long as dactyl; propodus 3.4 times length of dactyl.

Fifth pair of pereiopods with distal margin of propodus reaching beyond scaphocerite; ischium 0.52 times length of merus, 0.75 times length of carpus, 0.41 times length of propodus, 1.57 times length of dactyl; merus 1.47 times length of carpus, 3.1 times length of dactyl, 0.8 times length of propodus; carpus half as long as propodus, twice as long as dactyl; propodus 4 times as long as dactyl.

Pleopods with both rami well developed, except for first pair in both sexes; first pair with reduced endopod, lacking appendix interna. Second pleopod (Fig. 2d) of male with slender appendix masculina, reaching distal third of endopod, mesial border bearing 2 rows of 9 acute setae reaching apex; appendix interna moderately robust, reaching proximal third of appendix masculina.

Uropods (Fig. 2e) with protopodite with external lobe ending in sharp tip. Endopod shorter than exopod, with setae along posterior margin and distal half of lateral margins, posterior margin rounded. Exopod with bare, straight, lateral margin; ending in fixed spine, flanked internally by long, sharp, movable spine; diaeresis incomplete, marked by weak furrow extending through more than half the surface of ramus; internal and posterior margins with setae.

Remarks.—Macrobrachium tuxtlaense is probably more closely related to the cave-dwelling *M. acherontium* and *M. villalobosi,* all of which exhibit abbreviated development and are similar morphologically. These three species can be distinguished by the shape of rostrum, length of telson, extent of development of the eyes, and the different proportions of the segments of the first and second pair of pereiopods (Table 1).

Similarly to other species of *Macrobrachium* from the Americas with abbreviated development (e.g., *M. aracamuni* Rodríguez, 1982; *M. cortezi* Rodríguez, 1982; *M. reyesi* Pereira, 1986; *M. pectinatum* Pe-

Table 1.—Comparison of selected characteristics of *Macrobrachium tuxtlaense,* new species, from Los Tuxtlas region, Veracruz, and *M. acherontium* and *M. villalobosi.*

	M. tuxtlaense	*M. acherontium*	*M. villalobosi*
Rostrum	9–11 dorsal teeth/2 ventral teeth, reaching distal margin of scaphocerite	8–11 dorsal teeth/3 ventral teeth, reaching distal margin of scaphocerite	9–11 dorsal teeth/2 ventral teeth, reaching beyond distal margin of scaphocerite
Telson	1.2 times length of 6th abdominal somite	1.2 times length of 6th abdominal somite	1.4 times length of 6th abdominal somite
Eyes	Normally developed	Reduced, globose cornea, narrower than peduncle	Cornea absent
1st pair of pereiopods	Carpus 1.54 times length of chela	Carpus less than twice length of chela	Carpus twice length of chela
2nd pair of pereiopods	Covered with granules and small spines; ischium as long as merus and carpus, 0.53 length of chela	Smooth with scattered setae; ischium 0.93 as long as merus, 0.75 as long as carpus, and 0.63 as long as chela	Smooth with scattered setae; ischium 0.76 as long as merus, 0.5 as long as carpus and chela

reira, 1986; *M. atabapense* Pereira, 1986; *M. dierythrum* Pereira, 1986; *M. rodriguezi* Pereira, 1986; *M. pumilum* Pereira, 1986), *M. tuxtlaense* is a small-sized species with a maximum total length of 42.2 mm. In *M. tuxtlaense,* the egg size (2.8 × 2.5 mm) is the second largest among all *Macrobrachium* species from the Americas, the largest eggs (3.66 × 2.44 mm) being those of *M. ferreirai* Kensley & Walker, 1982 (see Magalhaes & Walker 1988, Pereira & Garcia 1995).

The evolution of abbreviated development in freshwater palaemonid shrimps has been linked to the invasion of nutrient-poor waters where planktotrophic larvae would die in the absence of phyto and zooplankton upon which to feed (Magalhaes & Walker 1988). The distribution pattern of species with abbreviated development coincides with the presence of oligotrophic waters such as small mountain streams or bodies of water inside caves. The three Mexican species of *Macrobrachium* with abbreviated development fit well this pattern, occurring in small streams where species of *Macrobrachium* with planktotrophic larvae do not occur.

Macrobrachium tuxtlaense possibly can be considered an endangered species as it posseses very limited dispersal capabilities and occurs only in two small tributaries of Lake Catemaco, an area that increasingly is being devoted to cattle ranching.

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